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The Institute's Proceedings

Volume 37 of the Proceedings of the Institute of British Foundrymen is now ready for distribution. It contains an account of the 41st annual general meeting and a selection of Papers to the Branches during the session 1943-44. This is the sixth issue which has been produced under war conditions, yet there is but little sign of physical deterioration, whilst so far as the matter is concerned, the level of technical excellence tends to rise. This may in a measure be due to the paper shortage, as nowadays there is only room to accommodate a selection of the Papers which are given under the auspices of the Institute, whereas in pre-war days there was less need for discrimination. Moreover, to-day the contents are in better alignment with the industry as a whole. Seven Papers are devoted to subjects which pertain to foundry practice in general; another seven are related to the cast-iron foundry; three to steel; two each to heavy non-ferrous, light alloys and die casting, and one to malleable practice. Future generations reading the wartime Proceedings will get but a poor appreciation of the contribution to the war effort made either by the industry or the Institute. True, there have been Reports on intelligent substitution, and Papers by Mr. J. Vickers on various aspects of the mechanised production of aero-engine parts. Yet the more studious observers will perceive in these Proceedings an excellent reflection of the character of the British technician. The refusal to be ruffled; the urge as far as is possible to uphold traditions; the absolute faith in ultimate victory characterise every volume. The British counterparts of Dr. Ley and Todt have never deemed it either necessary or desirable to use either the Institute or its publications for war propaganda. When the war is finished there will be no "Victory Convention," only the 42nd annual conference.

A feature of the Proceedings is invariably the Edward Williams Lecture. "Tolerances and Inaccuracies in Physics," by Sir Charles G. Darwin well maintains the high standard established. This was the seventh, and when this number has been doubled, we hope that these lectures will be collected and made the subject of a separate publication. As a mixture of science and philosophy, such a book would be an outstanding contribution to popular scientific literature. Unique amongst presidential addresses is that given by Mr. J. W. Gardom. Though the appeal it makes is not new, the novelty of the method of presentation somehow reinforces memory and makes for permanent appreciation.

To indicate any particular Paper as being of outstanding worth would be invidious, as the standard of value depends on individual tastes and requirements. The steelfounder and the maker of die castings are ill-placed to correlate the worth of the technical Papers covering each other's practice. At best there can be but a realisation of high merit. In this category enters quite a number of the Papers, and a difficult task awaits the committee charged with the selection of the best. There is a welcome tendency for the Proceedings to contain an increasing number of Committee Reports. This volume has three, the two major ones being on mechanical handling and the basic cupola. The former received initially a certain amount of adverse criticism, but on balance was accorded full approbation. The latter came in for universal commendation, and the major credit for this excellent piece of work is due to Mr. E. S. Renshaw.

Few people are aware of the difficulties attendant on the production of such a book as this under wartime conditions; obviously we are specially well placed to appreciate them in full measure, and this makes us all the more sincere in congratulating the Editor, Mr. J. Bolton, in having maintained if not enhanced the high standard achieved in recent years.

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NOTES FROM THE BRANCHES

LONDON BRANCH.—A meeting was held at the Charing Cross Hotel, London, W.C.2, on March 28, with the Branch-President (Mr. J. F. Kayser) in the chair. In accordance with the now well-established custom of exchanging technical Papers between British and American foundrymen, a Paper by Mr. A. Cristello (foundry manager, Eclipse-Pioneer Division of the Bendix Aviation Corporation), on "Gating, Risering and Chilling of Magnesium Sand Castings," was presented on behalf of the author by Mr. George Mann. It was an exchange Paper from the Metropolitan Chapter of the American Foundrymen's Association.

Four short Papers on foundry subjects were presented on behalf of the authors by Dr. A. B. Everest (Past-Branch-President). The meeting was asked to vote on the merit of the Papers, and prizes were awarded as follow in accordance with that vote:—First prize (a Gillette "Aristocrat" one-piece razor, presented by the Branch-President), to Mr. R. F. Lockyer for a Paper on "Mould Design for Aluminium-Bronze Die Castings"; second prize (two guineas, from Mr. V. C. Faulkner, Past-President of the Institute and of the London Branch), to Mr. W. Wilson for a Paper on "A Departure from Standard Practice." There were two further prizes of one guinea each (presented by Mr. Barrington Hooper, C.B.E., Past-President of the London Branch), awarded to:—Mr. W. G. Mochrie for a Paper on "Raw Material in Post-war Planning," and Mr. L. H. Akerman for a Paper on "Orthodox and Unorthodox Technique Applicable to Aluminium and Manganese Bronze."

Presenting the prizes, Mr. Kayser said that the four Papers were refreshing, particularly in view of the fact that they were written in really understandable English. At the conclusion of the proceedings, on the motion of Mr. Lockyer, seconded by Mr. Wilson, a hearty vote of thanks was accorded Dr. Everest for his very clear reading of the Papers.

SOUTH WALES AND MONMOUTHSHIRE BRANCH.—The President of the Institute, Mr. J. W. Gardom, accompanied by Mr. D. H. Wood, the Senior Vice-President, paid a visit to Cardiff and attended the February meeting of the Branch. In the evening, prior to the meeting, the Branch Council held a dinner at the Park Hotel, Cardiff, at which the Lord Mayor of Cardiff (Alderman W. C. Parker, J.P.) and Mr. Gardom were the chief guests. The Branch-President, Mr. H. J. V. Williams, was in the chair, and the following gentlemen were present:—Sir Robert Webber, J.P., D.L., president of the Cardiff Chamber of Commerce; Lieut.-Col. Percy Thomas, J.P., O.B.E., Ll.D., Regional Controller, Ministry of Production; Admiral Bartlett, Admiralty Regional Officer; Mr. H. Speed Peacock, general manager, Guest, Keen & Nettlefolds, Limited, Cardiff; Mr. Edward Jones, M.I.E.E., M.I.Mech.E., city electrical engineer and manager, Cardiff; Mr. G. E. Williams, managing director, John Williams & Sons (Cardiff), Limited; and Major E. Ivor David, consulting engineer, Past-President of the South Wales Institute of Engineers.

The toast of "The Lord Mayor and City of Cardiff" was proposed by Prof. W. R. D. Jones, and the Lord Mayor responded. Mr. C. E. Williams, J.P., who was President of the Institute in 1933, proposed the toast of "Our Guests," and gave a cordial welcome to Mr. Gardom. Both the President and Sir Robert Webber replied. The toasts were interspersed with musical interludes.

On the following morning Mr. Gardom and the Senior Vice-President, together with the Branch-President and Mr. Aubrey Williams, a member of the Branch Council, were received by the Lord Mayor of Cardiff at the City Hall, and before leaving signed the Visitors' Book. On the Saturday afternoon the meeting of the Branch was held at the Park Hotel, Cardiff, with Mr. H. J. V. Williams, the Branch-President, in the chair and supported by Mr. J. W. Gardom and Mr. D. H. Wood. At the outset the Branch-President gave a hearty welcome on behalf of the Branch to Mr. Gardom and Mr. Wood, and in reply the President said what a great pleasure it was for him to visit this Branch, and to see that it was so alive that something approaching 100 members out of a membership of approximately 150 were present, and, further, how pleased he was to see so many young members present. Mr. D. H. Wood, the Senior Vice-President, also thanked the Branch for the kind welcome, and expressed his pleasure at being present. The chairman then introduced Major E. Ivor David, who opened a discussion on "What the Engineering Industry Expects from the Foundry in Post-war years."

At the conclusion of the Paper, and after a full and interesting discussion, Mr. J. W. Gardom proposed a very hearty vote of thanks to Major E. Ivor David. This was seconded by Mr. E. J. Kelly, the Vice-President of the Branch. The business having terminated, all present sat down to a high tea.

A USEFUL ATTACHMENT

Electromagnets, Limited, 1, Bond Street, Hockley, Birmingham, 19, have designed and placed on the market a small permanent magnet for attaching to Sandslingers. By ridding the stream of sand just before it enters the impeller head of all tramp iron, the life of the blades is prolonged, the labour involved in replacement reduced, and the danger of flying metallic pieces removed. There are no moving parts to this magnet and efficiency of operation depends on the periodic removal of the tramp iron collected.

THE CENSORSHIP is now permitting the publication of some war-production figures. Amongst those of interest to our readers are some data released by K. & L. Steelfounders & Engineers, Limited. It appears that this steelfoundry has produced 405,000 aerial bombs ranging in size from 250 lbs. to 4,000 lbs., and a further 508,000 smaller ones—an admirable record.

THE RECLAMATION OF ALUMINIUM ALLOYS IN AN AERO-ENGINE FOUNDRY

Utilisation of secondary alloys dictated by wartime conditions

By A. H. RATHBONE

(*Continued from* 302.)

Briquetting

A further prior to melting process is being carried out with some success in connection with swarf reclamation. Briquettes are produced with a density as high as 97 per cent. of solid aluminium. With swarf below ¼ in. mesh. size it has been found that high melting losses are incurred, despite melting under a flux cover. This is due to the ease with which small particles oxidise and also to the fact that they tend to float on the surface of the flux. In order to counteract this, the swarf is screened before passing over the magnetic separator. All swarf which passes through ¼-in. mesh is fed into a rotary drier in order to dry off the oil still remaining after centrifuging. The swarf feeds from the drier into a pneumatic elevator which transfers it back to the magnetic separator. It is found that better separation of the screened swarf can be obtained when it is dry.

The press is a 400-ton toggle press, two briquettes being produced at each stroke at a rate of 10 strokes a minute. These briquettes are 3 in. dia. by 1 in. deep. The swarf is fed into the two moulds by means of a reciprocating feedbox. This feedbox is filled by means of two chutes leading from the storage hopper (Fig. 5). After the briquettes have been ejected the lower rams drop back to the bottom of the moulds, and the feedbox passes over, filling them with swarf ready for the next stroke. The pressure applied to each briquette is 200 tons. The density of the briquettes is subject to slight variation, but in all cases this should be higher than the density of the molten metal.

Swarf Melting

Underneath the main storage hoppers are two small traversing feed boxes. When a furnaceman requires material he operates a damper which allows the swarf to flow into one or other of these from the main hoppers. The feedbox is then moved along to the furnace feeding position and, by means of a lever which operates a trap, the charge can be fed into the furnace.

The swarf furnaces (Fig. 6) are of the rotary convertor type, lined with a high-grade silimanite refractory brick which has given excellent results. When charging they are swung to the forward position and the swarf is fed in. The operator then reverses the furnace to its firing position and turns on the burner, which is built into a refractory wall and is adjustable so that it can be lined up correctly with the top of the base curvature of the furnace. The burner itself is a 12,000 cub. ft. per hr. producer-gas burner of a type which has a long flame adjustment. The flame strikes the furnace lining, and the exhaust spreads around the furnace walls which absorb the heat, then, as the furnace rotates, this heat is taken up by the metal.

An exhaust canopy is provided which covers the entire furnace both in charging and firing position, and from the canopy an exhaust stack takes away all waste gases. Three furnaces of this type handle all the swarf, each being of ½-ton molten metal capacity when fully charged. When melting swarf, knowledge

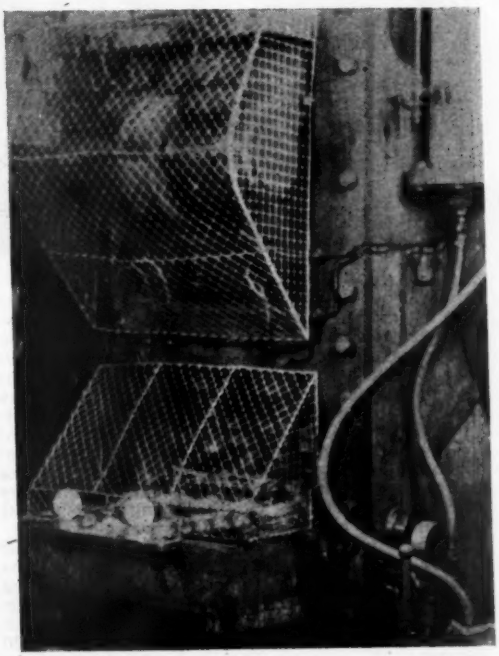

FIG. 5.—SWARF BRIQUETTING AT THE RATE OF 20 PER MINUTE.

Reclamation of Aluminium Alloys

of the yield obtained from each charge is of paramount importance. Poor returns or yields are almost invariably due to faulty melting practice on the part of the operator. If this can be detected immediately steps can be taken to prevent recurrence. In order to insure high yields, the melting of swarf is carried out under a molten flux cover. If swarf were melted in these furnaces without a flux covering of this nature, undue oxidation would be certain to take place, owing to the fact that each piece of swarf, as it melts, forms a globule of liquid surrounded by a shell of oxide. The skin tension of this oxide prevents coalescence, and, in consequence of the large surface area represented by the mass of globules, increase in oxide formation, and loss of yield is bound to take place. Therefore the skin of oxide has to be ruptured in order to allow coalescence. This can be accomplished by either physical, chemical, or mechanical methods. The molten flux cover mentioned above has a physical action, while a mechanical action is provided by the rotation of the furnace. The flux consists of an eutectic mixture of potassium and sodium chloride 45 to 55 ratio. This has been adopted as a standard for the following reasons:—(1) It has a physical action on the oxide; (2) the density is considerably less than that of molten aluminium alloy; (3) it is very fluid when molten; and (4) the melting point is close to the melting point of most aluminium alloys.

At the commencement of each shift 2 cwts. of the flux are shovelled into the furnace before releasing the charge of turnings. The furnace is then turned to the firing position and the flux heated to about 850 deg. to 900 deg. C. The length of time required for this is more or less constant, averaging about 15 to 20 minutes. The furnace is then turned over to its charging position, and about 60 lbs. of swarf is fed into the furnace, the rotation of which turns the swarf in, under the flux. The heat from the flux is rapidly transferred to the metal until a state of balance has been reached. The consequent cooling of the flux causes it to become "pasty" and in this state it forms a complete cover for the metal.

The 2 per cent. of oil still remaining on the turnings burns off and this forms a useful basis for determining when a state of complete covering has been reached, as the furnace is turned back to the firing position immediately the complete 60 lbs. is charged. From this position, of course, what is taking place cannot be observed owing to the burner and refractory wall. When the flame caused by the burning oil dies away the burner is started again. The burner is once again heated on a time basis, 4 to 5 min. being allowed. This brings the temperature back to about 750 deg. C. After melting has commenced the furnace should not be worked greatly in excess of 750 deg. in order to keep gas absorption by the metal down to a minimum. This process is repeated for the first three charges until the balance of the ½-ton is fed into the furnace at an increased rate of 89 to 90 lbs. per charge, the complete melt taking about 2 hrs. 15 min. from start to finish. By the time that the whole ½-ton has been melted, an increase in the viscosity of the flux has taken place, due to the taking up of the oxides and other impurities, such as hydrocarbons from the burnt oil. This enables the metal to be poured off from under the flux into the bogie ladle without difficulty.

The flux left in the furnace is at this point very thick, and if remelting were attempted a loss in yield would be the result. In order to bring back the flux to its original fluidity, about a ½-cwt. is taken out of the furnace and an equal quantity of new flux added. This, on being heated up, brings the flux back to a fully fluid state. In this manner five charges can be completed before a complete change of flux is required. This brings the flux metal ratio to 1 in 10 cwts. The average yield obtained from this method

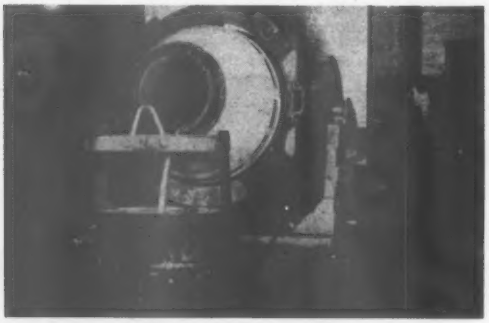

FIG. 6.—ROTARY FURNACE FOR REMELTING SWARF.

FIG. 7.—HOLDING FURNACE.

of reclamation is 91 per cent. When a charge is ready a bogie ladle which has been preheated is wheeled into the furnace room and weighed on a 3,000-lb. dial scale provided for the purpose. It is then placed under the furnace and the metal poured into it, after which it is again re-weighed in order to determine the actual metal weight. Knowing the input and output, it is a simple matter to express the yield in terms of percentage.

The metal thus obtained in the ladle is degassed by either the use of nitrogen or a suitable degasser of the chlorine releasing type, and finally skimmed off with a refining flux before being poured into the bath of the reverberatory or holding furnace.

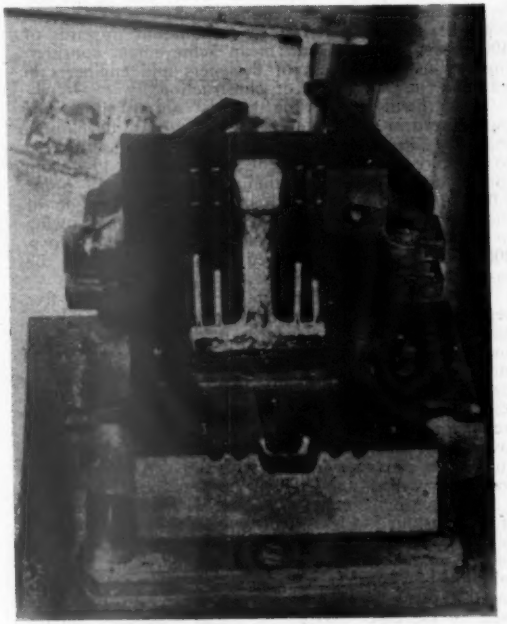

FIG. 8.—OPENED TEST-BAR MOULD.

Briquette Melting

The briquettes are melted in the same manner as the swarf under molten flux bath in order to prevent oxidation. With the density of the briquettes being above that of the molten metal, they sink to the bottom and the metal acts as a cover as well as the flux. The holding furnace (Fig. 7) is a cylindrical furnace firebrick lined, the dimensions of the interior being 3 ft. 6 in. dia. by 4 ft. deep; maximum allowed depth of metal being 2 ft. 6 in. At the top is a tangential flame burner which is necessary for preheating the furnace and holding the metal at temperature while casting. Similar tapping and casting arrangements are made to that previously described for the reverberatory furnace. When this furnace is in use it is necessary to plug up one of the reverberatory furnace tapping holes in order to leave a line of moulds free. This furnace is only used when a different alloy from that being melted in the reverberatory furnace is being cast.

Skimmings and Residues Section

Skimmings and residues are received at the opposite end of the department to the swarf where they are placed in bins after weighing. They are then hand sorted, and any residues containing a high percentage of metal are put into an adjacent bin for direct melting. The balance are fed into a ball mill. The ball mill crushes out and screens off all impurities in the form of oxides, spent flux, etc.

When the mill is reversed the metallics which are not ground down by this process feed out through a hollow trunnion. These metallics do, however, still contain a considerable amount of iron in the shape of core nails, core wires, chills, and so on. They are accordingly, before melting, passed over the magnetic separator. The furnaces are two 1,000-lb. capacity crucible tilting furnaces, the melting procedure being to commence the charge with a small amount of solid metal and about 56 lbs. of flux. The flux is in this case worked in a " pasty " state, not being allowed to liquefy; accordingly a higher melting point flux than the one used for swarf melting was considered desirable.

This was obtained by reducing the ratio of potassium chloride to sodium chloride, a 20: 80 ratio mixture being used. When the solid metal has melted and is brought up to a temperature of about 750 deg. C., a small charge of the skimmings is added. This is " puddled " into the flux in order once again to prevent undue oxidation. After allowing a few minutes to elapse, in order to heat up, the next charge is added, and so on until the complete charge is fed into the furnace. In order to obtain the most efficient results with this type of melting it is necessary to work the furnace between 700 and 800 deg. C., so that the molten metal does not become too cold nor the flux become too hot.

When the charge has been completed, the flux is skimmed off and the metal poured into the bogie ladle for weighing, the subsequent procedure being the same as that used for the swarf. The skimmed flux contains about 25 per cent. metallics, in consequence they are passed through the ball mill when cold in order to remove these metallics before discarding.

Metallurgical Control

This consists of routine analysis taken of every cast from the skimmings and swarf melting furnaces. This analysis is carried out by means of a spectrograph, suitable samples for this apparatus being taken immediately after casting into the bogey ladle. Complete analyses are thus available within 20 minutes of casting. Similarly, from the reverberatory furnace

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samples are taken every 20 minutes and suitable adjustments made to the bath should this be found necessary. Finally, from the ingot conveyor each batch of 30 cwts. carries two suitable test-bars which are representative of the batch. These bars (Fig. 8) are used for determining the physical properties, *i.e.*, ult tensile, elongation, and Brinell hardness, and also for checking the micro structure to ensure the absence of gas, oxides, etc.

Spectrographic Laboratory

The spectrographic sample is brought into the machine room of the laboratory where the pencil rods are cut from the spray by a guillotine and the cross-section turned on a small high-speed lathe. The Hilger medium spectrograph has a fixed slit width of 0.016 mm. and a height of just less than 1 mm. The electrodes are fixed 38 cms. from the slit and even illumination along the spectral lines is obtained by the use of a quartz lens placed 2 cms. in front of the slit. The lower electrode consists of the machined specimen and the upper electrode a 6½-mm. Hilger graphite rod pointed at the sparking end to an 80-deg. cone. There is a 2-mm. gap between the electrodes.

These electrodes are sparked for 20 sec. to allow the current to steady, then the Ilford thin-film half-tone plate is exposed for 25 sec. When the electrical current passes across the gap the spark vaporises the metal. The light from the vapour passes through the slit and an image of electrodes is formed on the collimator lens. The prism disperses the light and the plate photographs the final spectrum. The mains voltage is 220 volts stepped up to 1,500 volts on the spark circuit. Three standard samples covering the range required by specification are interspersed among the routine samples throughout the plate. The plate is then developed, washed and dried.

The plate is measured, using a Hilger non-recording microphotometer. The galvanometer deflections of the necessary line pairs are measured and the logarithmic ratio of the minor element to the major element is calculated. From the standards the graphs of the log ratios against the concentration of the minor elements can be drawn. From these graphs, and the calculated line pair ratios of the routine samples, the concentration of the minor elements (Mg, Fe, etc.) can be drawn.

It should be added that this plant is by no means an experimental venture. It is outside the province of this Paper to go into costing and production details, but it should be stated that a considerable saving has been shown at the factory since the inception of the reclamation department.

Acknowledgments

In conclusion, the Author wishes to thank the directors of Rolls-Royce, Limited, and also the Ministry of Aircraft Production, for their permission to present this Paper. His thanks are also due to Mr. John Vickers, foundry manager, for his helpful collaboration.

MAGNESIUM FOUNDING COMES OF AGE

This year marks the coming of age of the magnesium industry in Great Britain. In 1924, after two years of experimental work on the "Elektron" (magnesium) alloys, then in an early stage of development, Sterling Metals, Limited, entered into an agreement with F. A. Hughes & Company, Limited, to undertake the practical development of the patented processes owned by that company. The earlier years of the venture were naturally characterised by the customary admixture of struggle, success and disappointment inevitably encountered in the evolution of a new industry. The progress made, however, will be realised by the fact that in 1936 industry was absorbing castings in the new materials to an amount upwards of 400 tons per annum—no mean achievement considering the usual wariness of designers and engineers in adopting new materials of construction.

The growth of Sterling Metals' output shows the part played in the war effort by the rapidly developing industry. Production rose from the 400 tons of 1936 to a figure well in excess of 3,000 tons in 1944, and this figure excludes an annual production of some 7,000 tons of incendiary bombs. The magnitude of the effort involved is illustrated by the fact that, owing to the low specific gravity of the "Elektron" alloys, 800 tons of metal produced 2½ million gravity die castings of various weights and types.

This expansion has, naturally, during the past five years been absorbed into the war effort, and has been directed largely into transport fields, on land, at sea and in the air. At the same time, the advantages of ultra-lightweight metallic materials have been appreciated and utilised in all branches of engineering and scientific development. In heavy industry and lightweight precision engineering—indeed, in all cases where low weight and durability are essential to modern requirements—magnesium and its alloys are being increasingly called upon.

Sterling Metals' achievement in developing the uses of magnesium ("Elektron")—which will undoubtedly be a key source of material supply in the future—is one of which British industry can be proud. The development is the more important from a national point of view in that the processes now evolved and used by the chief magnesium metal producers can be maintained on an economic basis entirely by British raw materials and power. Thus magnesium is the only major constructional metal which, however widely it is adopted, will always be completely independent of imported raw materials—a most vital factor in time of national need and in view of the necessity of reducing external debt. Already British contributions to the interchange of foundry technique have offset some of our obligations under Lend/Lease.

"MODERN METALS," a monthly technical journal covering light metal interests, published its first issue in February from Burnham Buildings, Chicago 1, Ill., U.S.A.

THE BASIC PRINCIPLES IN THE FEEDING OF CASTINGS

Standard methods of running are compared with the Author's preferences

By J. G. NISBET

(*Continued from page* 297.)

A Hollow Cylinder Casting

For the component shown in Fig. 10 there are four possible ways in which to run it, and therefore to feed it. If cast horizontally, with a single top runner, it would be very successful, but as the thickness is insufficient, then most of the castings would be mis-run. Moreover, it is very doubtful if sound castings could be turned out because of the turbulent conditions of mould filling, with the metal stream being broken, and air being entrained, some of which will be prevented from escaping.

If the component is cast vertically with the runner and riser diametrically opposite on the top edge, then this system (shown in Fig. 11) is on the whole much better, although the straight drop of the metal is again conducive to turbulence. The separate riser affords a better air outlet, and if the diameter of casting is less than its height, this is a very good method, and considered good practice. Here again, though, the "thin-wall" problem remains, and would lead to ultimate mis-runs. On the other hand, by bottom-pouring (Fig. 12) eliminates turbulence, and, with the addition, perhaps, of a small top riser, it is not likely to lead to air traps. Its chief disadvantage, however, lies in the fact that the metal first entering the mould has to travel farthest, and should the casting be anything more complicated than just a plain cylinder, feeding cannot take place. The "thin-wall" problem still remains.

The fourth method (Fig. 13), and by far the best for die-casting components of this type, whether the end be closed or open and whether the cylinder be plain or embellished with bosses, webs, etc. Hundreds of thousands of pistons alone have been produced in this way from many different aluminium alloys, it being necessary only to adjust the cross-sectional area of runner and riser to suit the particular alloy used and also of the average section of the casting.

The special advantages realised when this form of side gating is adopted are: (1) The mould is filled gently, without turbulence, as the incoming metal displaces the contained air upwards and out of the die via the riser, the metal after entering the cavity remains quiescent; (2) it is fed from above by metal, which enters later—an ideal state of affairs; (3) internal or external bosses or ribs, etc., are sufficiently well fed without further precautions, as both runner and riser function along the entire length of casting, so that no part of it is any great distance from a supply of liquid metal.

Generally the height of runners is two or three inches for small castings; for medium castings three or four inches is sufficient; while for the largest castings six or seven inches is ample, and no advantage is gained by going beyond this.

Height, of course, means the head of metal, and is measured from the highest point of the casting cavity to the top edge of the die. The sectional form is relatively unimportant, so long as it will "leave" the mould easily. The cross-sectional area is important, for if a runner or riser be not sufficiently massive, it will fail to perform its proper function of

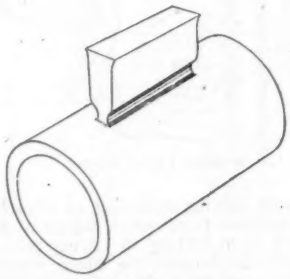


FIG. 10.—HOLLOW CYLINDER CASTING.

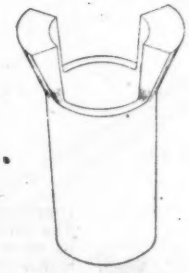


FIG. 11.—VERTICAL METHOD FOR CASTING CYLINDERS.

FIG. 12.—BOTTOM POURING CYLINDER CASTINGS.

Feeding of Castings

remaining liquid and providing a reservoir of molten metal from which the casting proper may draw. Shrinks, cracks, or cavitation will result. On the other hand, it is uneconomical to go to the extreme of relying on very heavy sections in every case, because production is hampered if the operator is obliged to wait a length of time after each cast before the die can be dismantled.

With another type it may be satisfactory to have

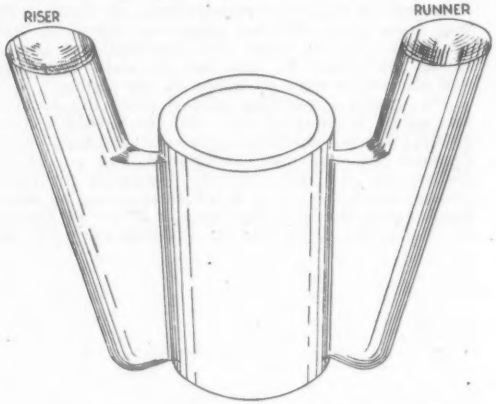


FIG. 13.—SUGGESTED "BEST" METHOD OF POURING DIE-CAST CYLINDERS.

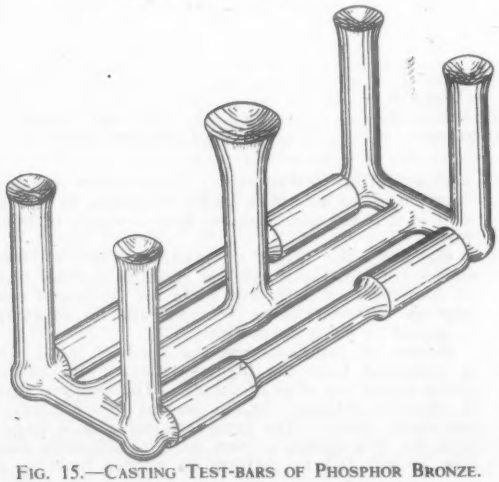


FIG. 15.—CASTING TEST-BARS OF PHOSPHOR BRONZE.

the gates and risers located on the edges or faces, yet they ought to be disposed so as to eliminate any trouble during fettling. It is a great mistake so to position a gate solely because its removal is simple and without regard to other and more important considerations—such as the feeding of bosses, avoidance of turbulence, possibility of blowholes on account of air traps, etc. On the other hand, one should not (except in very rare cases, such as occasionally occur on important high-class aircraft work) put risers where expensive machining operations are required to remove them. A simple casting where all these considerations are met is shown in Fig. 14, and also, if possible, where the die is designed so that all of it is sunk in the one die, which maintains accuracy, while at the same time facilitates machining. The other half-die is plain, simply serving to keep in the metal.

Phosphor Bronze

Both green-sand and dry-sand moulds are employed in phosphor bronze with a content in alloy of usually

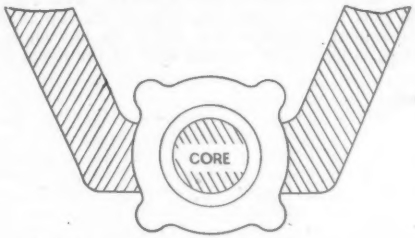


FIG. 14.—CORED DIE CASTING.

copper and tin with varying quantities of phosphorus. The phosphorus content from which the alloy derives its name may vary from 0.01 up to 1.5 per cent. The higher the phosphorus content the more penetrative the metal will be, and with this axiom in mind it will be shown how feeding affects this alloy. The gating is generally carried out either near the top of the castings or sometimes poured from the bottom, using a downgate.

Pouring temperatures play an important part in the production of sound castings. It is general practice that pouring temperatures vary from 970 and 1,100 deg. C. This wide range is due to the fact that a high phosphorus content enables the use of a very much lower temperature than a low phosphorus alloy. Risers or feeder heads are frequently unnecessary, particularly with small castings. If a casting is run from the top its runner will act as a riser. The reason for limiting risers and feeding heads is that it will increase the tendency for a more open grained casting, and consequently more porosity. Frequently runner bushes are used and their use is certainly to be recommended, particularly in the case of larger castings. It is the practice in some foundries to cover the opening of the runner with a thin strip of copper.

If a test-bar is cast in the usual manner, it is surprising how many methods are used in the feeding of this alloy. At one time it would normally be cast with a runner at one extreme end with a riser at the other. This method is quite good, but a disadvantage is the very unequal cooling, which results in the bars sometimes breaking at the shoulder, thus giving irregular results. Another method (Fig. 15) shows an improvement by running and risering both ends with the addition of a centre one the same size and thickness as the test-bar. In this way two or four bars can be easily cast from one central down-gate, either parallel or in the form of a square, the central down-gate being slightly restricted in order to keep the runner basin full. Very little metal is needed to cast, say, four bars, so this method is economical and uniform results are obtained.

Another method (Fig. 16) is to cast the bar vertical with a large feeder-runner. The results of this method are slightly lower than those described, and on the whole the test results are not so high.

The best method (Fig. 17), giving excellent results, and the most reliable of the four, is to employ a shaped bar with two ingates into the bar, running into a large feeding head. A choked down-gate is employed to run into the bottom of the head, or alternatively the metal may be poured directly into the head. In this way the bar is well fed and solidifies quickly, and at the same time a slight annealing effect is given from the still liquid head.

Many types of gates and runners are so well known in the industry that they are almost standardised. A self-feeding runner and gate (Fig. 18) for small castings in gunmetal and brass shows how this problem can be solved. The diameter of the cup should be three times the size of the runner, and its height two-and-a-half times this size. The sides of the cup should be straight, and when pouring the aim of the stream at ×. The reservoir at the bottom of the down riser fills up with metal and acts as a cushion against the descending stream; while the horizontal gate controls the stream, leading it more gently into the mould. Where a large number of boxes are cast from the one crucible, large gates will probably give sound castings over the whole range of casting temperatures.

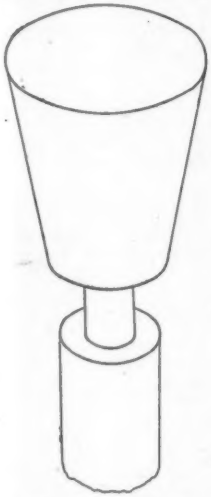


FIG. 16. — VERTICAL CASTING OF TEST-BARS.

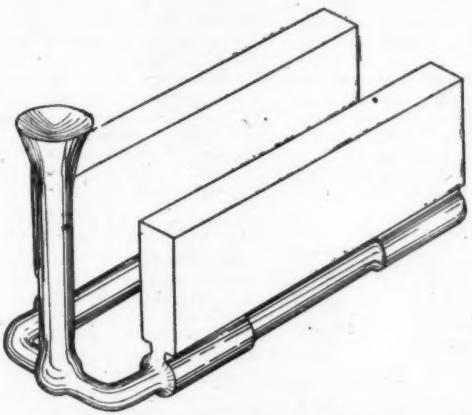


FIG. 17.—RECOMMENDED METHOD OF CASTING PHOSPHOR-BRONZE TEST-BARS.

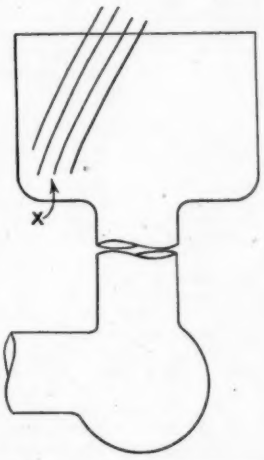


FIG. 18. — SELF-FEEDING SYSTEM FOR TEST-BARS.

Chills in Sand Moulds and Die Casts

Frequently there are thick sections in a casting which cannot be made to solidify quickly by normal moulding technique, or by their difficult location cannot be fed by a riser. If there are variations in thickness, usually the thick sections receive the coldest metal, so that they solidify almost uniformly with the thin sections. But even then risers are needed to feed liquid metal to the solidifying casting so as to prevent shrinks and draws, and the theoretical attempt to provide uniform solidification so that little feeding is required is rarely accomplished in practice.

To overcome the problem of obtaining a sound section at such a position, chills are used to obtain a rapid solidification of this point. The principle of the chill is that the high heat conductivity of the

(*Continued overleaf, column* 1.)

THE BASIC PRINCIPLES IN THE FEEDING OF CASTINGS

(*Continued from previous page.*)

chill compared with the low heat conductivity of the sand causes the heat to be taken away more quickly from the chill section than the metal adjoining in the sand mould, thus obtaining the liquid metal required for feeding it from other sections of the casting which can be fed by a riser.

In die-moulds the metal has superior physical properties to those of a sand mould or casting. In other words, a die-casting has a higher breaking strength, more ductility, and usually is harder than a sand casting in the same alloy.

When sections of a sand-mould casting (which do not normally require chilling) are so treated, the structure of the metal becomes similar to that obtained by a die-casting and also possesses similar physical properties. Chills used in moulds can be done in any metal. The ironfoundry would naturally use iron chills.

Any foundry specialising in either bronzes or aluminium alloys would naturally endeavour to make chills in their own alloy. The ironfoundry has found that there is no better chill than iron; but bronzes and brasses would be advised to use iron chills as well, since there is less chance of them sticking to the casting, and the capacity for iron to take heat is very good.

Aluminium foundries have a wide choice of metal for chills. Iron is good, with soft bronzes and brasses they can be used, but it is necessary to keep the surface free from contamination of a red-brown coating of oxide of copper, which is undesirable. If neither metal is obtainable, then aluminium-alloy chills can be used, but it would be best to increase their thickness of 50 to 100 per cent. to that of an iron chill. Their efficiency as a chill depends on the surface area available for chilling; the rougher the chill the more effective it is, consequently iron files broken up are often used.

NEW CATALOGUE

Flexible Bearings.—What interested the reviewer most in a catalogue received from Clayflex, Limited, of Tiddington Road, Stratford-upon-Avon, was the application of the "Clayflex" system of flexible bearings to mechanical screens. This bearing is composed of two tubes of widely different diameters, which have their interspace filled with prestretched rubber. Thus the bearing works equally well if taken out of alignment, while vibration is absorbed and noise eliminated. A number of interesting applications are described and illustrated in this 24-page booklet, which is available to our readers on writing to Stratford-upon-Avon.

MR. F. ANDREW, consulting engineer, of Failsworth, near Manchester, wishes to inform clients that his activities in connection with foundry practice are restricted to those not involving the use of an extensive drawing office staff.

NEW PATENTS

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

566,916 MOND NICKEL COMPANY, LIMITED. Production of composite metal products.

566,949 ENFIELD ROLLING MILLS, LIMITED, and SYKES, J. Copper alloys.

566,956 BRASSERT & COMPANY, LIMITED, H. A., and THOMSON, T. Treatment of ores.

567,000 HOLMAN BROS., LIMITED, and MICHELL, F. B. Method of and means for effecting mineral separations.

567,050 FOUNDRY EQUIPMENT, LIMITED, and BEECH, A. S. Sand mills and grinding machines.

567,052 ENFIELD ROLLING MILLS, LIMITED, and SYKES, J. Copper base alloys.

567,149 DARWINS, LIMITED, and LINLEY, A. Sand-cores or moulds for use in foundries.

567,172 SHORTER PROCESS COMPANY, LIMITED, and SHORTER, A. E. Surface hardening of hollow ferrous metal articles.

567,183 FALLON, J. Means for conveying goods through furnaces.

567,185 GLACIER METAL COMPANY, LIMITED, BATE, J., and JACKSON, F. W. Bearings for railway wagon axles and the like.

BLYTHE COLOUR WORKS' PROSPECTS

Mr. Norman R. Wildblood, who presided at the annual meeting of Blythe Colour Works, Limited, said that the first half-year's business was not too promising owing to the shortage and control of materials, labour and lack of shipping facilities, but the second half was much better and they were able to supply former customers in many parts of the world. The future seemed to hold good prospects with the cessation of hostilities, which should liberate more of their experienced men and improve the supply of materials for the production of vitreous enamels, glazes and colours for gas and electric stoves, baths, pottery, tiles, glass, paint, etc., all of which would be extensively required in the rehousing scheme.

It might not be generally known that for several years a good portion of their works had been requisitioned by the Government and, although they were still in possession, with the much improved war situation, the board felt justified in breaking away from the very necessary conservative policy of distributing dividends, Mr. Wildblood continued. There was always the possibility looming ahead that the whole works might be taken over and at one time they were within one hour of it.

DR. ZAY JEFFRIES has been appointed vice-president in charge (managing director) of the new chemical department of the [American] General Electric Company. He has been until recently technical director of this company's lamp department in Cleveland, Ohio.

THE MANUFACTURE OF SPECIAL HEAT-RESISTING CAST-IRON RETORTS*

By F. J. BULLOCK

Early in 1941 a contract was entered into for the manufacture of a very much-needed compound to be used in the making of explosives for war purposes. Drawings and specifications were supplied from overseas for the plant, which contained amongst its numerous details "Special Heat-resisting Cast-iron Retorts," to be made of special heat-resisting iron of a specified analysis and test requirements. It was decided, owing to the shipping difficulty and uncertainty, that these retorts should be made in South Africa immediately, as the ones ordered from England might never reach their destination, which might curtail the starting of the plant, as most other items were not a great problem to general engineering firms in South Africa.

The Author was warned that, owing to the very thin section and the very severe tests the casting had to undergo, there was only one firm in Great Britain that could make a satisfactory casting, and even they, with all their experience, usually had about 20 per cent. rejects.

Specification.—The retorts to be made of heat-resisting cast iron as detailed on sketch and machined over flanges and feet. Analysis: C, 0.4 to 0.8 per cent.; Gr, 2.2 to 3.0; Si, 1.0 to 2.0; Mn, 1.25; S, 0.12 (max.); and P, 0.5 per cent.

A test-piece of each cast had to be analysed to ascertain if the resulting castings were as specified.

Testing

The retorts had to be subject to two tests which were rigidly enforced.

Test No. 1.—The black casting, after being fettled, should have the stang irons in bosses cut off and riveted over, the retorts to be then subjected to a 10-min. air test by submerging under water, air to be at pressure of 12½ lbs. per sq. in. Any reasonable air leaks to be caulked, and resubmitted to test, if then not tight, retort to be rejected. If test satisfactory, retorts to be machined.

Test No. 2.—The machined retorts are to be subjected to a 60-min. air test submerged under water, attention being paid to possible leaks at machined feet. Any leaks are to be given one caulking only; if not then tight, retorts to be rejected.

Note.—Welding up of holes shall not be permitted; neither must the stang iron be drilled out, tapped and fitted with a screwed plug.

This test was considered rather severe by the foundry, considering that the metal was only $\frac{9}{16}$ in. thick, and the casting contained a flat face about 2 ft. by 5 ft., but when it is taken into consideration that these retorts have to hold within them superheated alcohol at 850 deg. C. at about 1½ lbs. per sq. in. when working, any leak would result in a great loss of valuable material with probably serious consequences, also involving great expense to renew them owing to the great difficulty in removing them from inside the furnace.

Making of the Pattern

After a long discussion with the patternmaker and the foundry foreman, it was decided to make the pattern with the joint cut along its length, thus making moulding easy. The pattern, being of a very simple nature, was made by boxing up in such a way as to avoid warping and alteration to important dimensions, due to the shrinkage and swelling of the timber when subjected to the different conditions, such as being rammed and remaining in wet sand for several hours, and then being withdrawn and left to dry out in a dry hot foundry atmosphere. The corebox was constructed with one side closed and the other open side being strickled off.

Core Iron

The core iron was given special consideration to prevent it from twisting in the two circular end prints, which were the only support to this heavy core. This was done by having two pieces across the end outside and beyond the prints, and these pieces wedged down to prevent any rotation of the core in the mould once it was fixed and the mould closed.

Moulding on End

After considerable discussion it was decided to mould the retort up on end in a special box that had provision for moulding a pattern in halves and, after the box had been closed, to turn it upon end for casting. This method was much favoured, because the core would practically be self-supporting and could not sag as would be the case if it were laid on its side. The runners in this core consisted of two down-gates in each side in one half of the box only and at the extreme lower end a dirt trap to catch any sand and heavy material that might be washed down the runner.

At intervals sprays were taken off, so that as the mould filled up the spray above the liquid level would come into operation and feed from the down-runner to the mould. Up to a point this method proved very successful, except that no one seemed to feel that the liquid pressure might be excessive and, on casting, the mould burst out at the bottom. It was now felt, however, that there might have been some weak spot in the mould, so a second one was moulded and cast the same way, with the same unfortunate results.

Mould Pressure

At this stage it is felt that a calculation of the pressure in the mould set up by the liquid pressure of the metal would have revealed the situation and prevented the unfortunate results, because, since cast iron is 0.26 lb. per cub. in., the pressure at the bottom of 1-in. height is 0.26 lb. per sq. in. Therefore, when "H" inches high, it will be 0.26 H-lb. per sq. in. In this case it was about 9 ft. Thus $108 \times 0.26 = 28$ lbs. per sq. in.

In most common castings made in a foundry the

* A Paper read before the South African Branch of the Institute of British Foundrymen, Mr. P. L. Ward presiding.

Heat-resisting Cast-iron Retorts

usual height or depth is about 24 in., which is 0.26 × 24 = 6.25 lbs. per sq. in. Hence about 4¼ times more than is normal in this foundry was expected. This pressure obviously can be withstood, but usually special precautions are taken and the boxes are of the solid plate type, such as used for ingot moulds, and not of the ordinary bar type, as was used in the case of the retort.

Moulding on Side

After the foregoing experience it was decided to mould the next flat on the side, using the same moulding box, except that the runners were slightly altered so as not to have the dirt trap at the bottom. Instead there was a scum trap arranged along the entire length by putting a portion of the runner containing the sprays in the drag portion of the mould and a thick scum trap in the cope portion of the mould. This ensured an even feed at all points along the length and also caught the dirt floating in the metal surface. Two castings were cast this way, with the result that the core lifted in the centre, due to the large flat surface subjected to pressure, which did not exist in the case of the ones cast up on end. This can easily be proved when considered, since the depth just before the mould is full is 6 in. Thus the pressure will be 6 × 0.26 = 1.56 lbs. per sq. in. Area subjected to pressure = 1,875 sq. in. Hence distributed load = 1,875 × 1.56 = 2,920 lbs.

Hence the lifting in the centre is quite obvious when one considers that the cross-section of the cast-iron core iron in the centre is only 1 in. by 2 in., taking its supports 8 ft. apart, acting as a simply supported beam carrying 2,920 lbs. as a distributed load.

Another two were made, and this time sufficient chaplets were put between the core and the mould to withstand the thrust, thus preventing the core lifting. This proved successful so far as getting a good casting out of the foundry, but the problem came when the first test was applied, the result being that under the air pressure all the chaplets were not issued to the casting and leakage occurred wherever there were chaplets. Further, these chaplets were not visible until the leaks were located and the metal chipped away, which goes to show that in thin castings made to withstand pressure, chaplets may be a source of trouble if one is not very careful.

Since six castings had now been made without actually getting one that was acceptable to the customer, it was felt that a special effort should be made to succeed next time. Four special chaplet plates were made. The head was 4 in. by 4 in. by $\frac{3}{16}$ in.; this and the stalk was $\frac{5}{16}$-in. dia. and 8 to 10 in. long. Since there was no objection to having the thickness of the head projecting on the inside of the casting, special prints were put in the corebox so as not to make the metal any thinner at this point than $\frac{3}{16}$ in. Further to assist, a boss about 1½ in. dia. by ¼ in. thick was added to the outside, resulting in the $\frac{5}{16}$-in. round stang iron being embedded in 1¼-in. thick metal, on to which it might be riveted, according to the specification, not absolutely airtight in the first tests. On careful inspection of the previous two castings, it was found that small air locks existed, due to casting a large flat face absolutely level. Therefore, as a further precaution, the one end of the mould was raised in order to cast "on the bank," the angle being about 30 deg. to 40 deg. from the horizontal, the same design of runner being used as in the previous two, with a common boss at the upper end to serve both downgates, into which the metal was poured with a small wedge-shaped riser off the upper side of the uppermost flange. This method proved very satisfactory, with only about 5 to 7 per cent. rejects, and equal to the imported retort, both in appearance and under actual working conditions.

After careful examination of the imported retorts, it appears that they have been run on the side with sprays, as was done here, and the chaplet plates were also embedded into bosses, but in addition there were some thick nail spikes projecting into the inside at the foot end of the retorts. This leads one to think that this is to prevent drawing in the vicinity of these feet.

In conclusion, the Author thanked Mr. West for his assistance, both in the preparation of this Paper and in the actual manufacture of these retorts.

DISCUSSION

The PRESIDENT (Mr. P. L. Ward) said that a Paper of this type, where problems were discussed and the various stages shown, explaining why the failure of one method led to the adoption of another method, was of particular assistance to members of the Branch. Papers of a general nature were essential, but he, personally, found Papers dealing with problems of particular value. Any member might be called on to make something very similar to the retorts described by Mr. Bullock. He thanked Mr. Bullock for his Paper and declared it open for discussion.

MR. WATTS suggested that the nails found in the imported castings must have been intended mainly to affect the internal distortion. He considered that if a chill had been placed on the external part, it would have had the same effect as the nails. Mr. Bullock agreed that the chills would serve this purpose.

In reply to Mr. West, MR. BULLOCK said that about 60 pockets had actually been made.

MR. WEST said that, to the best of his knowledge, not one of the locally manufactured castings leaked at that particular spot. It was after the imported castings arrived and several were found to have these nails projecting, that they had tried to discover the object of the nails, but without reaching any definite conclusion.

MR. BULLOCK agreed that none of the castings had leaked at that particular spot. He did not know where the 5 to 7 per cent. loss in rejects occurred, but thought that it was due simply to accidents in the foundry.

MR. WATSON pointed out that in all the rejected castings the leak was right at the bottom. He re-

ferred to the difficulties experienced by overseas foundries in casting the retorts.

MR. WATTS asked what would have been the effect of casting on edge, and Mr. Bullock drew a sketch on the blackboard to show why that method had been rejected on account of the great bending moment it involved. He suggested that by reversing the core iron it might have been practicable to cast on edge.

MR. HOLDSWORTH expressed his interest in the job. He stated that nails were a commodity stocked by all foundry suppliers overseas. The use of horseshoe nails in castings had started in the steel-casting industry. He was sure that, if the nails were examined, they would be found to be horseshoe nails. They were used in grey-iron castings to give a chilling effect on portions where there was likely to be porosity where a change of section took place. He emphasised the point that after six wasters had been made, a change of design was required. Why should that not have been discussed at the beginning, when the specification was received? If that opportunity had been given at the start, considerable time and money might have been saved. The studs and chaplets had been allowed to protrude into the core, which was a very sound practice.

Assessing the Blame

Referring to Mr. Bullock's statement that the moulder had not calculated the pressure which the casting would have to withstand, Mr. Holdsworth was of opinion that the moulder was not to blame, but the men in charge for not giving him the tackle that he should have had. He saw no reason why the job should not have been cast on end. He considered that if the boxes had been suitably constructed, there should have been no risk of any metal getting away. This method of casting the job would have eliminated the studs, which were a source of leakage in the tests. The use of chaplets for holding the core was a good method, however. Nevertheless, he thought that casting flat was the better method, because if any foreign body got in and floated on the metal, the ribs would take care of it, whereas casting on side might result in a cold lap.

MR. WATSON considered that, when casting on end, it stood to reason that the metal coming in from the bottom and driving gases to the top surface would lead to trouble, since there was not sufficient metal to drive it back again.

MR. HOLDSWORTH did not agree with Mr. Watson. In his opinion, Mr. Watson was correct in casting on the bank, not in order to get the air away, but to eliminate the chance of cold lapping and causing a leakage.

Horseshoe Nails

MR. TONGE supported Mr. Holdsworth's explanation regarding the practice of embedding horseshoe nails in the core. He believed that a successful casting could have been made on end, which would have been one method of ensuring that the air was got away. Making on the flat and casting on a bank was an efficient method, however, as results had proved. He congratulated Mr. Watson on his perseverance. Seeing that only one foundry in Britain had been able to produce a good casting, it was highly creditable that a South African company should have succeeded with only 5 to 7 per cent. of wasters.

In reply to questions from Mr. Holdsworth and Mr. Tonge, MR. BULLOCK said that the job had been made in dry sand and weighed about 1,250 lbs. Answering the President, he said that the operating pressure of the retorts was about 1½ to 2½ lbs. at a good red heat.

Question of Design

MR. WEST emphasised that no modification of the design had been applied for. Bosses were shown on the original drawing. The job had been started before they knew what it was for, and they had thought that the bosses might be for screwing and tapping. They had been warned not to use chaplets under any circumstances. Only after the sixth casting had been made did they realise the purpose of the bosses. If the job had not been so urgent, they might have been able to give it more thought.

MR. HOLDSWORTH deplored the practice of giving foundries drawings with no explanation. If the company had known what the job was for and under what conditions it was going to work, it would have helped them enormously. That was the first information which a foundry should be given. The bosses were only a function of standard practice.

The PRESIDENT said that South Africa was becoming more involved in the manufacture of chemical plant, and it was frequently stipulated that no chaplets should be used. In the case of the retorts, if chaplets had not been permitted, there would have been no way of casting the job except on end with an ingot mould type of box, eliminating all possibility of a burst out at the bottom. He was extremely grateful to Mr. Bullock for having delivered one of the problem Papers which he personally liked so much. He suggested that another "Problems Evening" might be held in the near future.

Answering Mr. Steinhardt, MR. BULLOCK said that the retorts had to stand up to a working temperature of 850 deg. C.

MR. STEINHARDT referred to the manufacture of a vessel which had to stand up to 1,090 deg. C., a nickel-chromium alloy being used. To come up to the casting temperature had been very difficult. The alloy had eliminated nearly all scaling and would stand up for many months to temperatures from 1,000 to 1,100 deg. C., which he thought was the highest working temperature possible for any nickel-chromium alloy.

Replying to Mr. West, MR. BULLOCK said that the temperature of the retorts never dropped below 500 deg. C. He had observed no bulging at that temperature and no growing of the iron.

MR. HOLDSWORTH emphasised that it was of great importance to the foundry, where it was stipulated that chaplets should not be used, that that stipulation should be made before the contract was placed, owing to the vast difference in the expense involved.

CORRESPONDENCE

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

"SOME OBSERVATIONS ON THE STRUCTURE OF ACID RESISTANT VITREOUS ENAMELS FOR CHEMICAL PLANT"

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—We have read with great interest the letter from Mr. Montgomery which you published in your issue of March 15, and are very glad to have a contribution to the discussion on our recent Paper from one of the actual fabricators of the acid-resisting vitreous-enamelled plant.

Mr. Montgomery's comments refer to the application of the high-frequency spark test described in our Paper in testing the continuity of enamel coatings, and he appears anxious to restrict its use in favour of the "wet" test, on the grounds that the "Sesco" type of tester will, under certain abnormal conditions of both the enamel and the manipulation of the testing device, produce flaws in an enamel coating. He suggests, for example, that where the effective thickness of the enamel coating is of the order of 0.003 in., *i.e.*, something less than one-tenth of the normal thickness of enamel found in chemical plant, it is possible by means of the application of a high voltage to break down the insulation provided by this extremely thin layer of enamel. In support of this an experiment is described in which a piece of cover glass which had been subjected to the solvent action of hydrofluoric acid, and thereby reduced in thickness to 0.003 in., was fractured immediately by the application of a spark from a "Sesco" tester. In view of the fact that the breakdown of an insulating medium is a function of the thickness of the medium and the magnitude of the applied voltage, it is not surprising that a high-tension voltage which is quite harmless at normal thicknesses of enamel should cause breakdown of the insulation of an extremely thin layer of glass, especially one which has been corroded, probably unevenly, by hydrofluoric acid. The fact that the wrongful application of a useful means of testing enamel might cause misleading indications to be made is no justification for the abandonment of the test when made under correct conditions of application.

The feature which Mr. Montgomery does not mention in our application of the high-frequency spark test is that in every case where the test, applied to normal enamel linings, revealed the presence of a defect, a large void of the type illustrated in the Paper was found when a section was taken and examined under the microscope. Mr. Montgomery surely does not suggest that these large voids, which incidentally are really serious discontinuities in the enamel coating and not local fractures such as would result from the electrical breakdown due to an unreasonably high applied voltage, are formed in the enamel as a result of the use of the high-frequency spark testing procedure.

Regarding the various "wet" tests, we feel it is not sufficiently appreciated that methods of test in which an electrolyte is employed are not to be relied upon to indicate the presence of defects. Quite serious discontinuities in enamel can escape detection when the "wet" testing procedure is employed. The corrosive media employed in the chemical industry, however, are not slow to take advantage of the discontinuities in enamel linings despite the fact that the "wet" tests have failed to indicate the presence of flaws. Of course, with mildly corrosive media such as milk or beer, local discontinuities in the enamel are not likely to bring about premature failure of the containing vessel because of the slow rate of attack on the exposed metal, but this is not the case with chemical plant. Hence, in quoting records of length of equipment life, it is essential to bear in mind the whole of the facts and in particular the media which had been in contact with the enamel, otherwise misleading conclusions could be drawn.

Referring now to Mr. Montgomery's statement regarding the bubble structure exhibited by commercial enamels, we would repeat the view expressed in our Paper, that it is the large voids which are seriously deleterious to the performance of the protective enamel coating. As regards the smaller voids, we cannot escape the conclusion that virtue is being made out of necessity when it is suggested that a glass lining containing voids has better physical properties than one which is absolutely free from bubble defects. We should be much happier with this statement if any factual evidence could be provided in support, particularly as it is entirely at variance with the extensive and widely published experimental work carried out on glass (Prof. W. S. Turner and others) where it is shown that the elimination of minute imperfections has a profound effect in increasing the strength of the glass.

May we conclude by expressing our appreciation of the interest shown by Mr. Montgomery in the work we have carried out on vitreous enamels and our hope that work will be undertaken with a view to the elimination of these serious defects from enamel linings of vessels, etc., intended for use in the chemical industry.—Yours, etc.,

G. E. CHARLISH.
E. J. HEELEY.
Materials of Construction Laboratory,
I.C.I., Ltd., Dyestuffs Division.
Hexagon House, Blackley,
Manchester, 9.
April 6, 1945.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I was most interested to read the letter by Mr. W. Montgomery published by you on March 15. It is an exceedingly useful contribution to the discussion of the Paper by Messrs. Charlish and Heeley. On the question of the bubble structure in enamels conferring better physical properties, however, I am not in entire agreement. Porosity in materials of con-

(*Continued on facing page.*)

NEW TRADE MARKS

The following applications to register trade marks appear in the "Trade Marks Journal":—

"HADRIAN"—Steel and unwrought iron. R. N. DODDS & SONS, Hadrian Road, Wallsend-on-Tyne.

"PYTHON"—Metal pipe clips. C. W. CHENEY & SON, LIMITED, Factory Road, Soho, Birmingham, 19.

"QUICKFOR"—Machine belt fasteners of metal. QUICKFOR, LIMITED, 482, Manchester Road, Heaton Chapel, Stockport.

"UNI" AND DEVICE—Grindstones. UNIVERSAL GRINDING WHEEL COMPANY, LIMITED, Universal Works, Doxey Road, Stafford.

"TYRESOLES"—Metal moulds and rims, machines, hand tools, etc. HENRY SIMON, LIMITED, Bird Hall Lane, Cheadle Heath, Stockport.

"REPUBLIC"—Electric measuring instruments and apparatus. WIZARD PRODUCTION COMPANY, LIMITED, 16, Withy Grove, Manchester, 4.

"GLOCO" AND DEVICE—Metal tanks and containers. GLOBE TANK & FOUNDRY (WOLVERHAMPTON), LIMITED, Birmingham Road, Wolverhampton.

"STEAM-MARSHALL" AND DEVICE—Steam generators and boilers. MARSHALL, SONS & COMPANY, LIMITED, Britannia Iron Works, Gainsborough, Lincs.

"SERPEX"—Bricks, etc., of refractory material for use in furnace building. SHETLAND MINERALS, LIMITED, 79-87, Station Lane, Oughtibridge, Sheffield.

CORRESPONDENCE

(*Continued from previous page.*)

struction does not generally improve physical or mechanical properties, except perhaps in the case of refractories where spalling resistance is concerned. The view has, indeed, been put forward by many ceramists, but without experimental evidence, that the bubble structure of enamelled iron enables the enamel layer to withstand better the tensional and compression forces set up by differential expansion and contraction.

Some experiments I was privileged to be associated with some years ago did not support this view. The tests were carried out on Armco iron, coated with the same enamel, but fired under varying conditions to give normal and bubble-free enamels. The enamelled strips were then tested in a bending machine described in your journal in 1939. The results demonstrated that better adhesion was obtained the fewer the bubbles. In a bubble-free enamel the test-pieces were bent almost double before fracture occurred.—Yours, etc.,

G. H. ABBOTT.

"Firstone," Wombourne Common,
Wolverhampton, Staffs.
April 9, 1945.

STEEL INDUSTRY PROBLEMS

Referring to problems confronting the steel trade at the annual meeting of Hadfields, Limited, Sir Peter B. Brown, chairman and managing director, said that throughout the year frequent changes in the type and amount of the Government requirements had been experienced. At one time the output of their electric and open-hearth melting departments was reduced to less than 50 per cent. of the same period in 1942, but that only lasted for a few weeks and the position had since improved materially. Government controls were, of course, necessary during special emergencies, but the most irksome were those that prevented firms from quickly adapting themselves to changing conditions and making full use of their plant and facilities. In some of their departments the pressure for more and more output had been maintained and they had had many complimentary messages from the various Service departments.

As to the future of their company, Sir Peter thought they were likely to be fully employed for a few years after the war in supplying the immediate needs of the home and overseas markets.

ENGINEERS CALL FOR TAX CONCESSIONS

The Engineering Industries Association has sent a memorandum to the Chancellor of the Exchequer on the subject of income-tax and E.P.T. The Association urges (*inter alia*) that the relief provided in the Income-Tax Bill, 1945, in respect of buildings and plant, etc., is required immediately by the engineering industry in order to assist the provision of much needed funds for rehabilitation and post-war planning. Furthermore, relief is required at 100 per cent. by way of a charge against E.P.T. liability. Regarding E.P.T. post-war credits, the memorandum says that the lack of information available in connection with the form to be taken by these is having a serious effect upon industrialists, particularly in the engineering industry, who desire to plan elaborate programmes of peace production, and are being called upon by various Government spokesmen to make a vast effort in maintaining full employment.

CONTROL OF MACHINE TOOLS

The Ministry of Supply announces the formation of a panel of technical advisors to assist the Director-General of Machine Tools on special technical problems associated with particular types of machines. The members of the panel are as follow:—Mr. H. W. Smith (B.S.A. Tools, Limited); Mr. G. W. Nash (Buck & Hickman, Limited); Mr. J. G. Petter (Cincinnati Milling Machines, Limited); Mr. H. T. Millar (Churchill Machine Tool Company, Limited); and Mr. H. A. Chambers (Associated British Machine Tool Makers, Limited).

The members of the panel will serve in their personal capacity, either individually or jointly.

NEWS IN BRIEF

F. R. SIMPSON & COMPANY, LIMITED, is being wound up voluntarily. Mr. J. W. Harrison, Rise Carr Rolling Mills, Darlington, is the liquidator.

OF THE MORE THAN 65,000 persons employed by the Associated Electrical Industries group of companies, approximately 42 per cent. are women.

WILLIAM GRAY & COMPANY, LIMITED, the West Hartlepool shipbuilders, have announced that they have sufficient work in hand to keep the yard working at full pressure for at least 12 months.

THE POSSIBILITY of America becoming an important competitor in the steel export market after the war was stressed by Mr. John Brown, general secretary of the Iron and Steel Trades Confederation, in an address at Redcar.

AN ORDER FOR Morris industrial engines has been received from liberated Norway by Morris Industries Exports, Limited, the export branch of the Nuffield organisation. The order originated from the Norwegian Ministry of Supply and Reconstruction.

GUEST KEEN BALDWINS IRON & STEEL COMPANY, LIMITED, announce that they have reopened their London office at 6, Broadway, Westminster, S.W.1. Mr. J. R. Shaw, who was previously in charge of their London office, has returned as their representative.

THE ANNUAL REPORT of the Lanarkshire Steel Company, Limited, states that the works have been fully employed during the year, although output has been curtailed due to shortage of fuel. The utilisation of waste heat has effected economies in production costs.

MR. JOHN BROWN, general secretary of the British Iron, Steel and Kindred Trades Association, addressing a social gathering of steel workers at Redcar, said that, when the history of the war was written, he was satisfied that the sacrifices made by the iron and steel workers of Great Britain would find an honourable mention.

HEENAN & FROUDE, LIMITED, structural manufacturing engineers and ironfounders, of Worcester, announce that they have acquired the controlling interest in Industrial Waste Eliminators, Limited, engineers and contractors to the meat and by-products trade, of Baldock, Herts. Heenan & Froude, Limited, have also acquired for cash the business of the New Destructor Company, Limited, destructor engineers, ironfounders, etc., of Pershore, Worcs.

DETAILS OF SOME of the wartime productions of George Cohen, Sons & Company, Limited, engineers, etc., have recently been announced. The companies in the group played a major part in the construction of reinforced caissons for the Mulberry harbour, while they were also extensively engaged in the manufacture of ammunition and other warlike stores, aircraft parts, plant, machinery, steel castings, etc. Other of their activities included the supply of hundreds of thousands of tons of ferrous and non-ferrous scrap.

THE A.I.R.O.H. ALUMINIUM HOUSE, which recently passed the technical tests of the Ministry of Works, is to be put into production at a West of England factory controlled by the Bristol Aeroplane Company, Limited. Large-scale work will be in progress by June. Four factories in various parts of the country have been chosen to produce the building, and the West of England plant will be the parent concern. It is understood that negotiations are in progress for the production of aluminium houses in Dumbarton in the factory of Blackburn Aircraft, Limited.

THE OFFER BY THE Staveley Coal & Iron Company, Limited, to acquire the share capital in Bradley & Foster, Limited, of Darlaston, having been accepted by the requisite number of shareholders, the merger has now taken place. Of the present directors of Bradley & Foster, Messrs. R. W. Hale, John H. Lones, H. J. Peart and F. S. Towle have vacated their seats on the board and have been succeeded by Messrs. H. H. Berresford, T. A. McKenna, and N. R. Rees. No change in the management of Bradley & Foster is contemplated, and the company will continue to trade under the direction of Mr. G. T. Lunt (managing director) and Mr. J. E. Hirst (technical director).

THE PRODUCTION of pig-iron, steel and rolled products in Brazil during the first six months of 1944 showed a notable increase over the corresponding period of last year, according to the "Iron Age." During the half-year 29,643 metric tons of pig-iron, 99,379 metric tons of steel and 78,894 metric tons of plates and sheets were produced. These figures represent increases of 67 per cent., 81 per cent. and 66 per cent. respectively over the corresponding period of 1939 and increases of 12 per cent., 21 per cent. and 13 per cent. of the corresponding period of 1943. There are twelve concerns at the present time producing iron and steel in Brazil, eleven of them manufacturing plates and sheets. Some 89 per cent. of the pig-iron, 94 per cent. of the steel and 88 per cent. of the finished products were produced by five companies.

DARLINGTON & SIMPSON ROLLING MILLS

Following Government sanction for the installation of new rolling-mill plant for the production of light steel special sections granted to the Darlington Rolling Mills Company, Limited, steps are being taken to consolidate the operations of Darlington & Simpson Rolling Mills, Limited, which hitherto has been the holding company. These steps involve the winding up of the subsidiary companies, as a result of which the parent company becomes the operating company, to which will be transferred all assets and liabilities of the subsidiary companies. Mr. J. W. Harrison, managing director of the parent company, has been appointed liquidator for this purpose. The consolidation of operations now taking place in no way affects the manufacturing activities of Darlington & Simpson Rolling Mills, Limited.

Save Fuel
IN YOUR CUPOLAS
BY USING
STANTON
SAND-LESS
MACHINE CAST
PIG IRON
THE STANTON IRONWORKS COMPANY
LIMITED NEAR NOTTINGHAM

COMPANY RESULTS

(Figures for previous year in brackets.)

Stewarts and Lloyds—Dividend on deferred stock of 12½% (same) and on the liaison deferred a dividend at the same rate relatively as on the deferred.

Vulcan Foundry—Profit for 1944, after provision for general repairs and depreciation, £221,810 (£169,113); tax provision, £195,796 (£144,833); ordinary dividend of 5 per cent. (same); forward, £45,451 (£44,526).

Millom & Askam Hematite Iron—Net profit for 1944, £60,250 (£57,481); taxation took £25,000 (£100,000); written off fixed assets, £25,000 (£30,000); dividend of 10% (same); forward, £46,277 (£42,631).

Worthington-Simpson—Net profit for 1944, after depreciation and taxation, £23,092 (£21,106); ordinary dividend of 8% (7%); to general reserve, £5,000 (£5,000 for deferred maintenance); forward, £30,965 (£30,064).

Brush Electrical Engineering—Profit for 1944, £147,257 (£175,002); final dividend of 6%, making 10% (9%); to general reserve, £40,000 (£25,654); provision for taxation, 1945-46, £82,500—less previous over-provision of £32,500; forward, £11,560 (£11,532).

Wallsend Slipway & Engineering—Net trading profit for 1944, after depreciation, income-tax and E.P.T., £144,855 (£52,508); profit on sale of investments, etc., £3,149 (£629); preference and ordinary dividends, £95,958 (£66,152); final ordinary dividend of 11% (8%) and bonus of 10% (5%), making 30% (20%); A.R.P., £12,000 (£5,000); general reserve, £30,000 (nil); forward, £34,881 (£29,335).

CONTRACTS OPEN

Any date given is the latest on which tenders will be accepted. The address is that from which forms of tender may be obtained.

Belfast, April 23—Iron castings; brass meter taps; service and condenser tubes; cast-iron pipes, compo pipe and pig-lead; purifier grids, etc., for 12 months from July 1, for the Town Council. The Engineer and Manager, Gasworks, Ormeau Road, Belfast.

Flint, May 12—Providing and laying about 300 yds. of 5-in. dia. and about 1,300 yds. of 4-in. cast-iron pipes, for the Borough Council. Williams & Clarke, engineers, 5, Godstall Chambers, Chester.

Leamington Spa, April 23—Construction of approximately 430 yds. of 8-in. and 650 yds. of 6-in. and 4-in. cast-iron gas mains, etc., for the Town Council. Mr. J. Sutcliffe, borough engineer, Town Hall, Leamington Spa.

OBITUARY

MR. PERCY HUDSON, chairman of Robert Hudson, Limited, railway equipment manufacturers and iron and steel founders, of Leeds, died recently.

MR. HARRY EMMOTT, a director of Tootill & Snape, Limited, textile engineers, of Radcliffe, Lancs, died on April 3, aged 67. He was chairman of the company for a long period and for 30 years he was a member of Manchester Royal Exchange.

PERSONAL

MR. H. M. SUTHERLAND, secretary of the company, has been appointed a director of Davy & United Engineering Company, Limited.

MR. F. R. TOTTING has been appointed manager of the engineering department of William Denny & Bros., Limited, shipbuilders and engineers, of Dumbarton.

MR. DENIS H. H. CLARKE has been appointed a director of James Booth & Company, Limited, manufacturers of non-ferrous tubes and rolled metal, etc., of Birmingham.

MR. A. HARRISON, sales manager of W. H. Dorman & Company, Limited, manufacturing engineers, ironfounders, etc., of Stafford, has been appointed a Justice of the Peace for the Borough of Stafford.

MR. ALLAN STEVENSON, a director of David Rowan & Company, Limited, marine engineers and boiler makers, of Glasgow, has been elected president of the Institution of Engineers and Shipbuilders in Scotland.

SIR CLIVE BAILLIEU succeeds Sir George H. Nelson as president of the Federation of British Industries. He is on the boards of a number of companies, including the Amalgamated Metal Corporation, Limited, the Imperial Smelting Corporation, Limited, and the Zinc Corporation, Limited.

MR. WILLIAM H. HIGGINBOTHAM has been elected chairman of Edgar Allen & Company, Limited. He is an incorporated accountant and joined the company in 1930 as secretary, a position which he has now relinquished. In 1933 he was appointed a director, since when he has taken charge of the financial side of the company's activities.

SIR ERNEST SIMON, governing director of the group of Simon companies, was recently presented with a portrait painted by Mr. T. C. Dugdale, R.A., on the occasion of his 65th birthday. The presentation was made by Mr. Jack Mallard, the shop stewards' convenor, on behalf of the works and staffs of Henry Simon, Limited; Simon-Carves, Limited; Henry Simon (Engineering Works), Limited; Turbine Gears, Limited; and Tyresoles, Limited.

MR. STANLEY CLOWES, general works manager of Craven Bros. (Manchester), Limited, machine-tool makers, ironfounders, etc., who has been with the company since 1928, has been appointed a director. MR. WILLIAM LORD, general office manager, who has been in the service of the company for 32 years, has also been appointed to the board, while a third appointment is that of MR. WILLIAM D. MOORE, chief accountant of the company since 1928.

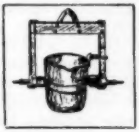
Wills

SANDERS, A., of Bristol, a director of the National Smelting Company, Limited £12,099

BIRD, SIR ERNEST EDWARD, director of the Park Gate Iron & Steel Company, Limited, and other companies £264,507

COLDWELL, C. B., of Sheffield, late managing director of W. B. Coldwell & Sons, Limited, gauge and tool makers, Sheffield £1,738

DAVIES, HENRY ALOYSIUS, of Wednesbury, Staffs, director of the Patent Shaft & Axletree Company, Limited, British Basic Slag, Limited £14,368



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Raw Material Markets

IRON AND STEEL

There is not much change in the position governing the ironfoundries or the situation at the furnaces. There is no doubt that the supply of high-phosphorus pig-iron is stringent and that the Control have some difficulty in meeting the needs of the light-castings trade, who are the principal users of this type of iron. The output of iron at the present moment is not sufficient to meet consumers' requirements and still retain reserve stocks, as most of the production is being disposed of immediately. Licences are being granted for sufficient tonnages to keep the foundries going, but there is no scope for them to build up stocks.

The light foundries are reasonably busy, and they would take on more work but for the shortage of skilled labour. There has been some extension in the last few months in the demand for light castings for the building and general domestic trades. With regard to the general engineering and allied foundries, the position is somewhat patchy. Some of the foundries continue to be well employed on the production of high-duty castings for tank work, armaments, munitions and other Government requirements, while other foundries and some of the jobbers are wanting more work. The pig-iron necessary for these foundries is a little more plentiful, and they do not experience any difficulty in getting licences for their requirements in low- and medium-phosphorus iron, or refined pig-iron. These foundries would like to use more hematite pig-iron than the Control are willing to allow, although it is understood that the stocks of hematite are now better than they have been and there is some evidence that a little more tonnage is being released.

Ironfoundries are somewhat concerned about the position of iron and steel scrap, particularly in the heavy grades. Deliveries have been very slow for some weeks. Speciality foundries also require ferro-alloys in their mixtures and no difficulty has been experienced for some time in getting supplies, particularly of ferro-silicon and ferro-manganese.

The coke zoning scheme is now operating in additional areas, and consumers are having specified tonnages allocated to them from their normal colliery sources. Deliveries are now coming through satisfactorily.

Ever since the stoppage of shipments of American semi-finished steel to this country the need for the maintenance of home production at maximum levels has been imperative. At the moment the pressure for blooms, slabs and the larger billets is a little easier, but, on the other hand, the consumption of bars in the sheet mills has increased and consumers are pressing for increased deliveries. The position is, in fact, so tight that sheet rollers have overcome their reluctance to use defective bars, which are now as readily saleable as defective billets.

NON-FERROUS METALS

The consumption of copper by brass mills in the United States was a record figure last February, and the monthly average last year was 138,004 tons. Generally, however, both here and in America, the demand for copper, though on a good level compared with pre-war figures, is not so good when compared with the wartime curve.

Arnhem is now occupied by the Allies, but news about the tin smelter there is not yet published. With the end of the war in Europe, it may be found necessary to readjust the selling price of tin. Supplies in this country at present are ample, though the War Production Board in America has reported a new low level in its stocks and that the imports of tin (in all forms) only expressed about 75 per cent. of requirements.

Plenty of zinc is available and waiting to go into consumption for civilian goods when the word is given. U.S. reserves, however, are less easy, and it has been recommended that the present import duty there should be guaranteed for five years.

Aluminium is more in the limelight as an increasing export trade is developing. The new "M-4" floating bridges made in America are almost entirely of aluminium, and call for a 65 per cent. increase in production by June. In Tasmania it has been stated that construction may start on the new aluminium reduction plant before the end of the year.

A note of special interest is that cadmium is in a very tight position in America owing to special military demands.

NEW COMPANIES

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, Ltd., Chancery Lane, London, W.C.2.)

Liners & Pistons, 135, Manningham Lane, Bradford—£1,000. F. Senior and J. Bentley.

Allied Metals, 21, Warwick Grove, Clapton, London, E.5—£1,000. B. Davis and V. J. L. Gooding.

S. Goodchild, 36, High Street, Brentwood, Essex—Engineers. £2,000. S. J. and I. F. Goodchild.

Pitman, Berry, 44, Chepstow Road, Newport, Mon—Engineers. £2,000. C. H. Pitman and F. J. Berry.

Wrekin Welding Company, Slaney Street, Oakengates, Salop—£1,000. C. F. Round and M. Kieft.

Allan Furnaces, 7, Oakfield Road, Cannon Hill, Birmingham, 12—£500. H. W., D. F., and P. J. Allan.

Halsen Asbestos & Engineering Company, 14, Billiter Street, London, E.C.3.—£10,000. J. Hall and L. G. H. Bull.

Canopy Engineering Company, 186, Forest Road, Loughton—£1,000. W. M. Pope, N. Moore, and G. P. Relph.

THE ANNUAL GENERAL MEETING of the Slough Section of the Institute of British Foundrymen will be held at the "Good Companions," Slough, on April 26, at 7.30 p.m. It will be followed by a talk by Mr. A. Logan, the president, on the work of the Technical Council of the Institute.